

Micromirror array as an architectonic component

PATENT CLAIMS

1. A micromirror apparatus (12) having a plurality of individual bodies (31) which are connected to a common base mounting surface (30), with one individual body (31) containing at least one standing holding element (32; 32A, 32B), which is raised above the base mounting surface (30), for a mirror element (36) which is connected to it and has an optically reflective effect, with the elements (32; 32A, 32B; 36) of the individual bodies being structural elements composed of layers of a thin-film production process, characterized in that

a) the material for the base mounting surface (30) is chosen in advance from the group comprising:

organic or inorganic glasses, plastics, in particular polymers, metals

b) the material for an optically effective layer of the mirror elements (36) is chosen in advance from the group comprising:

metals, in particular homogeneous metal alloys, dielectrics, in particular dielectric multiple layers, reflective plastics, in particular highly reflective polymers, and

c1) the material for the holding elements (32; 32A, 32B) is chosen either such that it is suitable for selective use

as a sacrificial layer in an etching process with respect to one of the materials chosen in advance,

or

c2) the material for the holding elements (32; 32A, 32B) is chosen such that it allows selective growth, in particular by the use of an electrochemical action in polymethyl methacrylate (PMMA) formed by deep lithography.

2. The apparatus as claimed in claim 1, in which the mirror elements (36) are in the form of a reflective metal layer or a dielectric multiple layer with an electrically conductive single layer or are in the form of a reflective polymer layer with a conductive single layer.

3. The apparatus as claimed in claim 1, in which the apparatus contains connecting elements (22, 24) by means of which it can be connected at the edge to other apparatuses (12) of the same type.

4. The apparatus as claimed in the preceding claim, in which the apparatus contains plug-in connecting elements (22, 24), and in which the connecting elements contain not only the mechanical connection but also an electrical plug-in connection between apparatuses of the same type.

5. The apparatus as claimed in claim 1, in which the mirror elements (36) are either

- a) designed to be flat, or
- b) they have a curved shape.

6. The apparatus as claimed in claims 1 and 5, alternative a), in which the mirror elements (36) are rectangular.
7. The apparatus as claimed in one of the preceding claims, in which the mirror elements (36) are arranged in the form of a regular matrix comprising parallel rows and parallel columns.
8. The apparatus as claimed in claim 1, in which a mirror element (36) is in the form of a structural element of a metal layer or of a dielectric multiple layer with a conductive single layer, or of a conductive polymer layer with reflective characteristics, and in which the mirror element (36) is mounted such that it can move relative to the base mounting surface, for an actuation mechanism which acts on the mirror element, by virtue of its own predetermined bending stiffness or the bending stiffness of its connection to the holding element.
9. The apparatus as claimed in claim 1, in which the actuation mechanism for the mirror elements is based on electrostatic forces, and in which at least one first electrode (34; 36) is associated with a mirror element, and at least one second electrode (38) is associated with the base mounting surface (30).
10. The apparatus as claimed in the preceding claim, in which a flat opposing electrode (38), which is common to a plurality of or all of the mirror elements (36), is provided

on the base mounting surface (30), and an electrical supply line (26, 28), which leads to an outer edge of the apparatus, and contact between the electrodes and individual single bodies (31) or groups of individual bodies is provided by means of planar lines, for computer-controlled addressing and actuation of the individual-body movement via the electrode pairs (34, 38).

11. The apparatus as claimed in claim 1, in which a mirror element (36) is connected via at least one bridging element (34) of predetermined bending stiffness to the holding element (32; 32A, 32B).

12. The apparatus as claimed in claim 1, in which the mirror element (36) is attached to two bridging elements (34A, 34B) which, running in an essentially parallel direction, form a pivoting axis for the area of the mirror element (36), and act on opposite sides of the mirror element, and in which the twisting stiffness of the bridging elements (34A, 34B) about their pivoting axis can be matched to the electrostatic forces between the electrodes (34; 38) such that a pivoting movement of the mirror element (36) can be carried out with a specifically variable deflection angle relative to the base mounting surface (31).

13. The apparatus as claimed in the preceding claim, in which a mirror element (36) is mounted in a universally jointed manner by means of a further bridging element pair

(84A, 84B), which is provided within the pivoted area according to the preceding claim.

14. The apparatus as claimed in one of the two preceding claims, in which the mirror element (36) is oriented with respect to the pivoting axis such that a pivoting axis divides the mirror element (36) off-center.

15. The apparatus as claimed in one of the preceding claims, in which the mirror element (36) is in the form of a Bragg filter element, and has a filter function which can be spectrally tuned by means of the control voltage which is applied between the electrodes (34, 38).

16. A panel (15) containing an apparatus (12) or a plurality of apparatuses (12) as claimed in one of the preceding claims.

17. The panel (15) as claimed in one of the two preceding claims, also containing a power supply connection (21) and a device (16) for reception of control commands from a controller (18).

18. A system for designing building facades containing one or more panels (15) as claimed in the preceding claim, a controller (18) for controlling the deflection of micro-mirrors (36) of the panel (15), as well as a device for transmission of control signals to the panel (15).

19. A lithographic method for production of a micromirror apparatus as claimed in claim 1, characterized in that

a) the material for the base mounting surface (30) is chosen in advance from the group comprising:

organic or inorganic glasses, plastics, in particular polymers, metals

b) the material for an optically effective layer of the mirror elements (36) is chosen in advance from the group comprising:

metals, in particular homogeneous metal alloys, dielectrics, in particular dielectric multiple layers, reflective plastics, in particular highly reflective polymers, and

c1) the material for the holding elements (32; 32A, 32B) is chosen either such that it is suitable for selective use as a sacrificial layer in an etching process with respect to one of the materials chosen in advance,

or

c2) the material for the holding elements (32; 32A, 32B) is chosen such that it allows selective growth, in particular by electrochemical action in polymethyl methacrylate (PMMA) formed by deep lithography.

20. The use of an apparatus (12) as claimed in one of the preceding claims 1 to 15, or of a panel (15) as claimed in claim 16 or 17, or of a system as claimed in claim 18 in an installation for designing building facades, including their windows.

21. The use of an apparatus (12) as claimed in one of the preceding claims 1 to 15, or of a panel (15) as claimed in

claim 16 or 17, or of a system as claimed in claim 18 in an installation for use of solar energy.

22. The use of an apparatus (12) as claimed in one of the preceding claims 1 to 15, or of a panel (15) as claimed in claim 16 or 17, or of a system as claimed in claim 18 as a headlight, in particular for motor vehicles.

23. The use of an apparatus (12) as claimed in one of the preceding claims 1 to 15, or of a panel (15) as claimed in claim 16 or 17, or of a system as claimed in claim 18 in conjunction with lamps on a reflector basis for specific light deflection and/or light focusing.

24. A headlight, containing a light source and at least one micromirror apparatus (12) as claimed in one of the preceding claims 1 to 15, arranged in a predetermined orientation with respect to one another in a reflector housing.